Automating Wet Chemical Analysis

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A World of Solutions

Who Should Automate?

Anyone looking to improve laboratory efficiency

- Environmental
- Agricultural
- Food and beverage
- Pharmaceutical
- Mining
- Etc.

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Advantages of Automating

Save time
Decrease cost
Improve quality
Reduce waste
Proven methods

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Benefits of Automation

Improve efficiency

Release staff from mundane chores

More samples per day

Increase capacity

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Economic Advantage

Increased capacity = higher profit

"Silent hours" – 3x throughput

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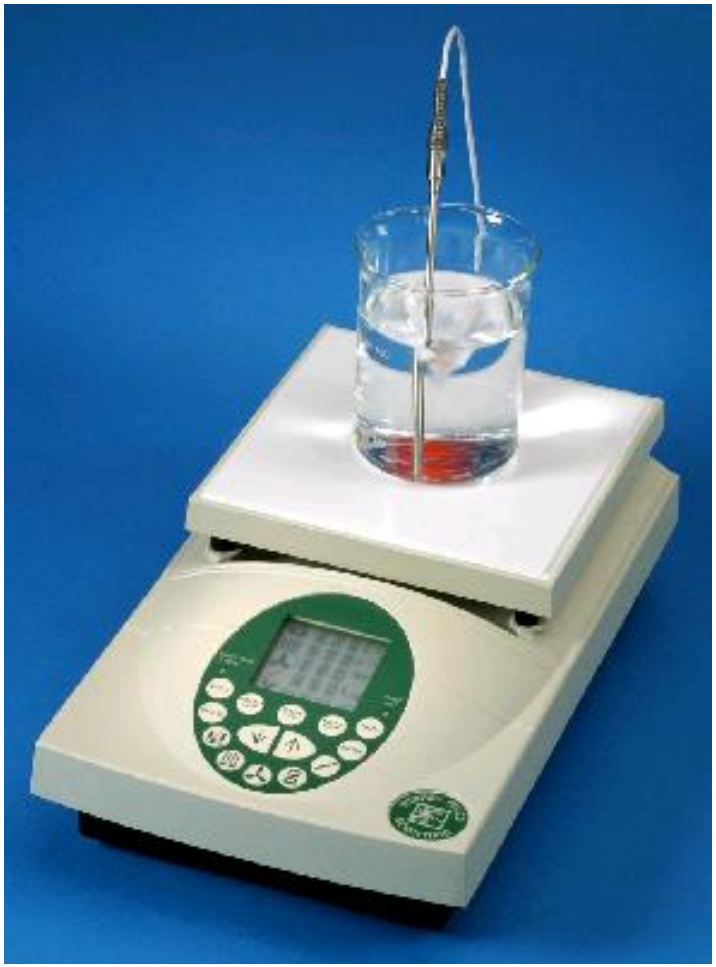
Simplest Form of Automation



Making a mundane task easy

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Automated Chemistries

- Alkalinity
- Ammonia
- Chloride
- Nitrate
- Nitrite
- Nitrogen, Total Kjeldahl (TKN)
- Phenolics
- ortho-Phosphate
- Total Phosphorus
- Silica
- Sulfide
- Sulfate

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Sample Types

- Brackish waters
- Drinking water
- Groundwater
- Wastewaters
- Surface water
- Industrial waste
- Process water
- Plating baths
- Seawater
- Soil and plant extracts
- Tobacco extracts

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Sample Preparation

Digestion
Distillation
Solvent extraction
Gas diffusion
Dialysis

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Sample Preparation Examples

Total Cyanide
Total Phenolics
Total Nitrogen
Total Phosphorus
Surfactants

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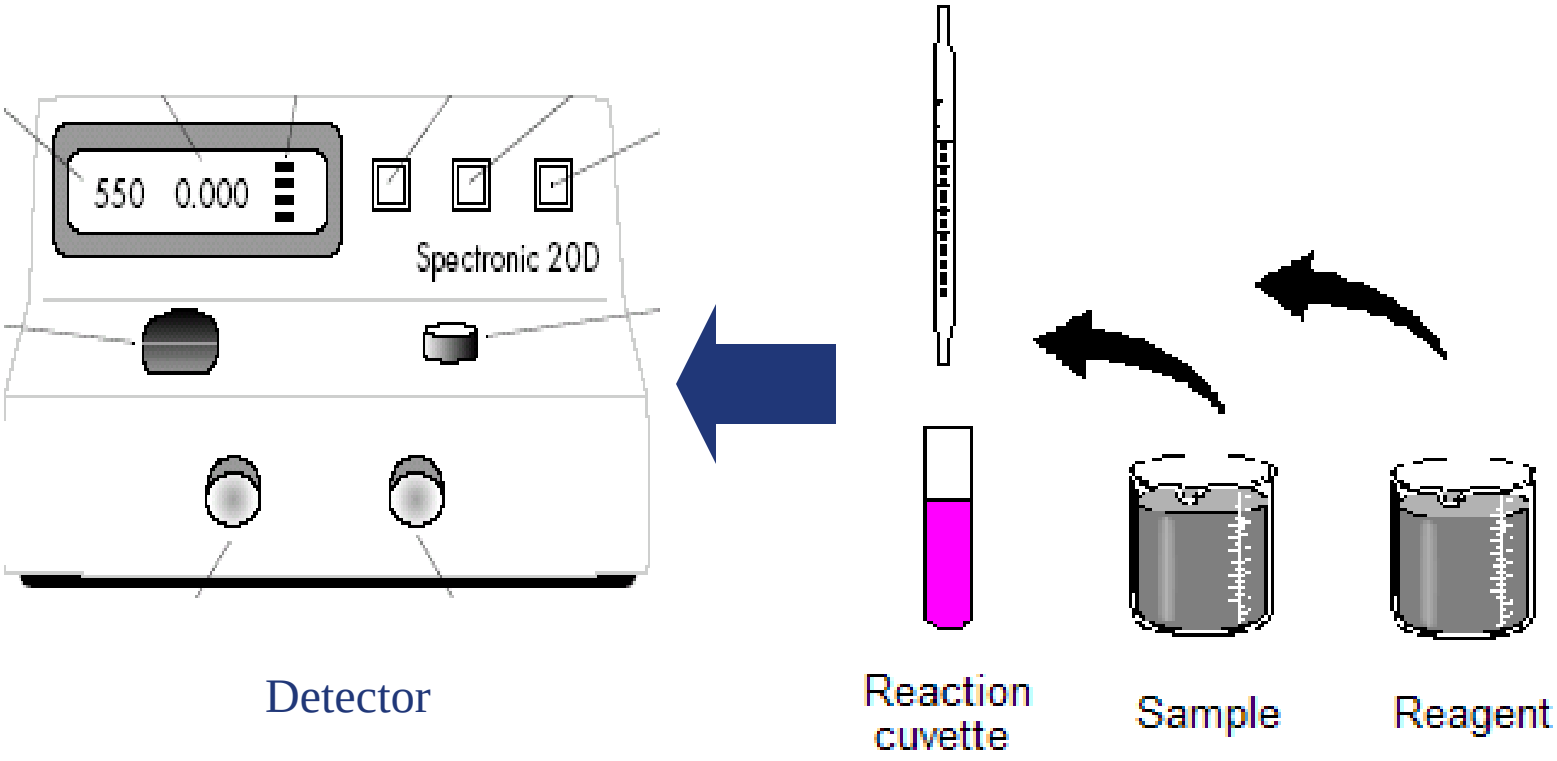
Manual Method Process



Boring and Mundane

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Criteria for Automation

Cost divided by 3 - 5 years should be less than annual cost of the manual method (labor + reagents)

"easy-to-use", and not complicated

Better results than manual method

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Answer These Questions

- How many samples do I have?
- How many different tests will I do?
- How many different tests per sample?
- How many samples per same test?

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More Questions

Will I have a lot of samples for the same tests?

Or, will I have a lot of tests for a few samples?

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Answers to Questions

It is economical to automate both

a lot of tests for few samples

a lot of samples for a few tests

The automation technique is what varies

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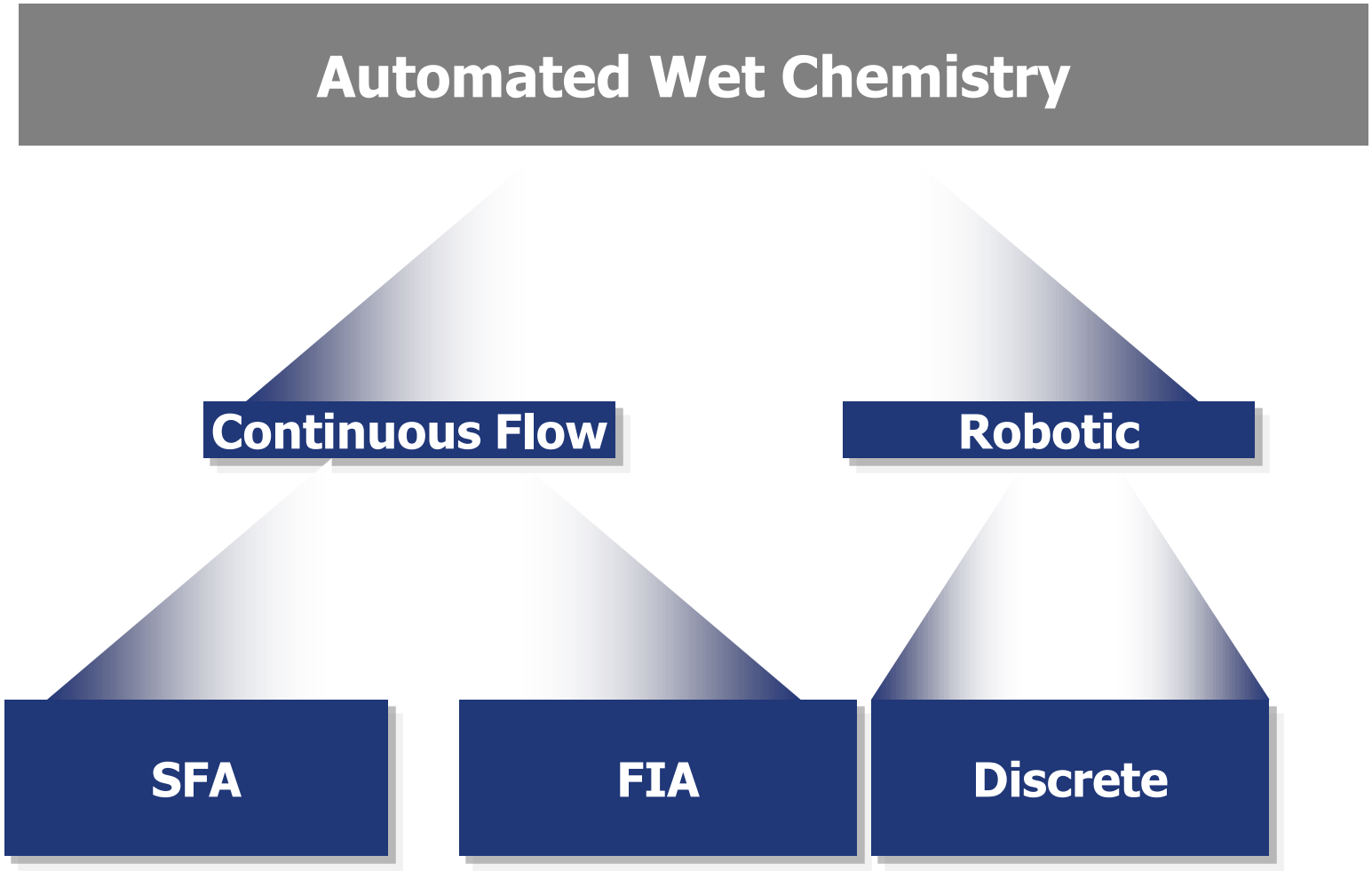
Technology



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Continuous Flow

- Continuous flowing stream
- Mixing coils
- Detector

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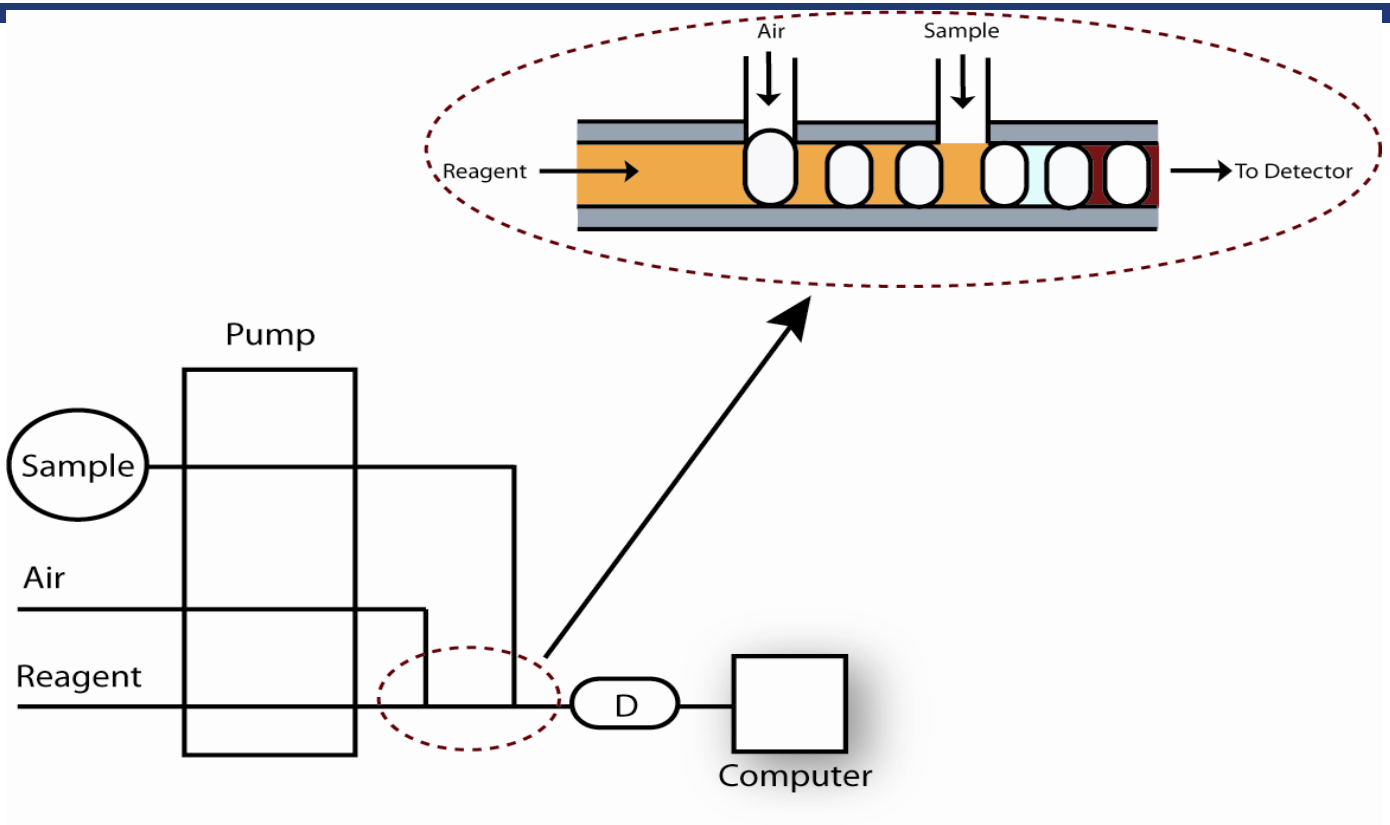
Segmented Flow Analysis (SFA)



- Original Automated Analyzer
- Approved in regulatory test methods

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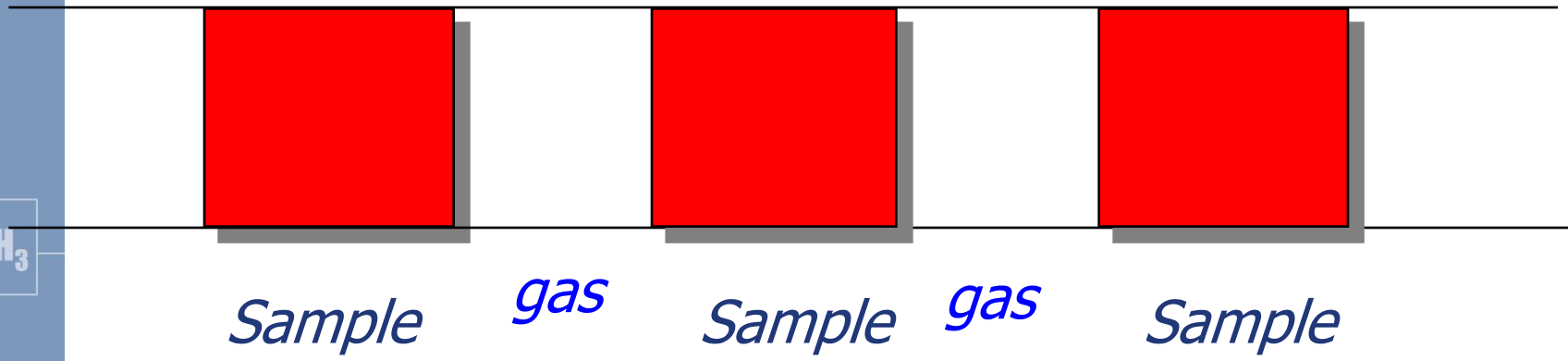
SFA Sample Segment

After segmentation within chemistry cartridge.



CN
NH3
PO4
NO3
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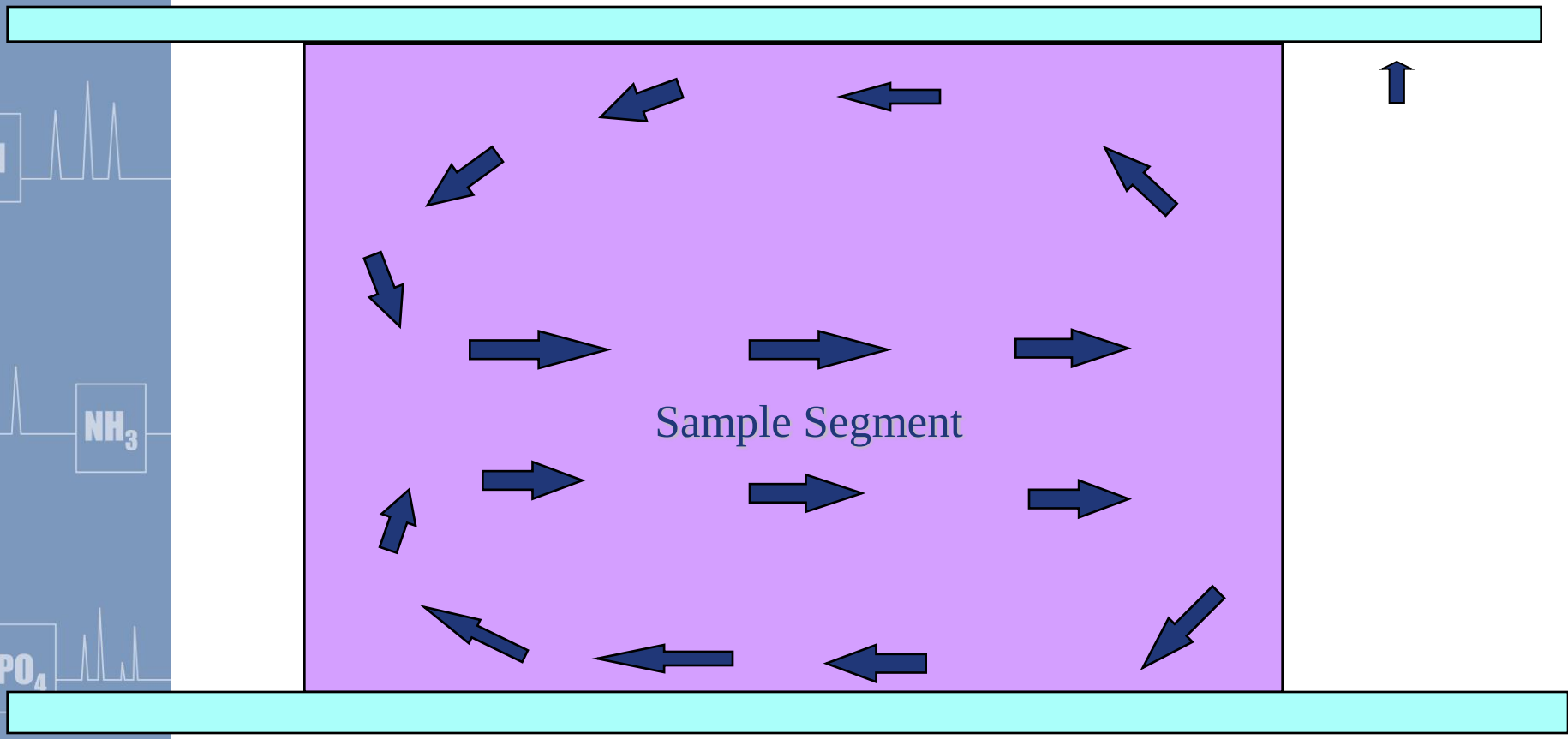
SFA Sample Segment



CN

NH_3

PO_4

NO_3

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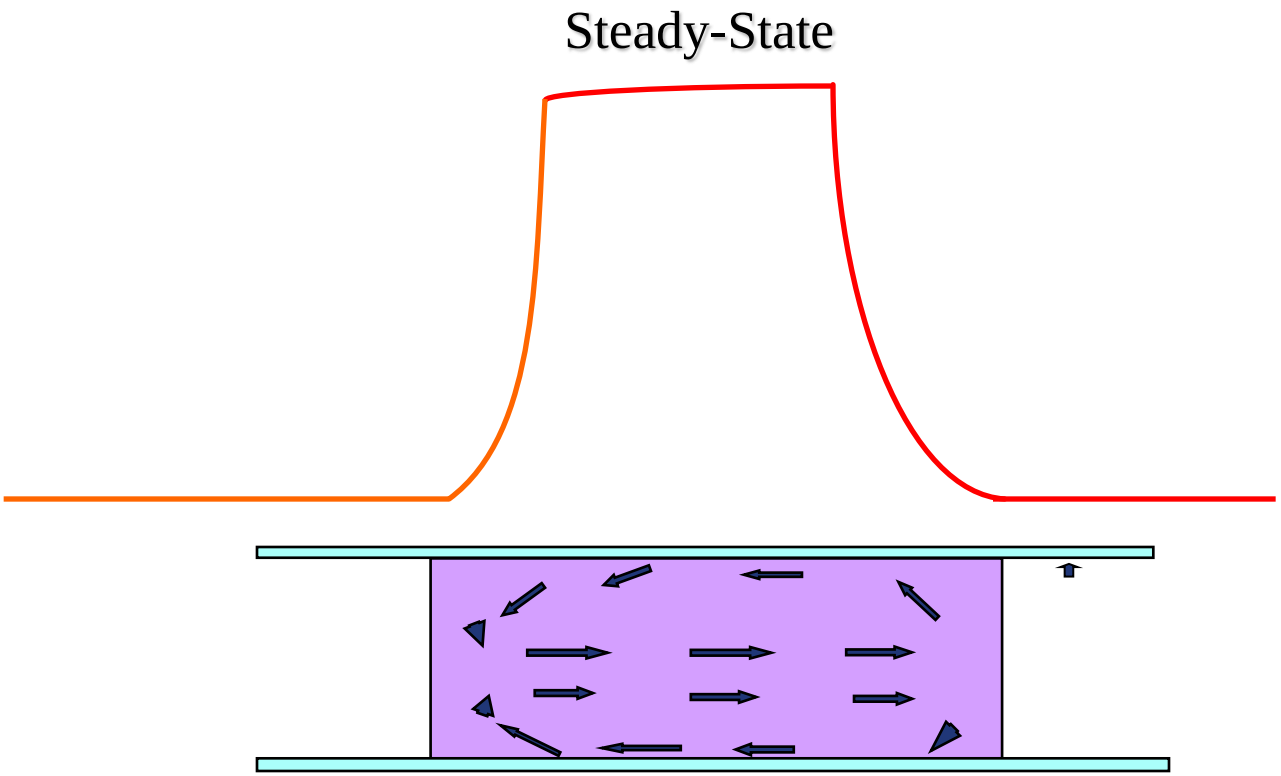
SFA Peak Shape



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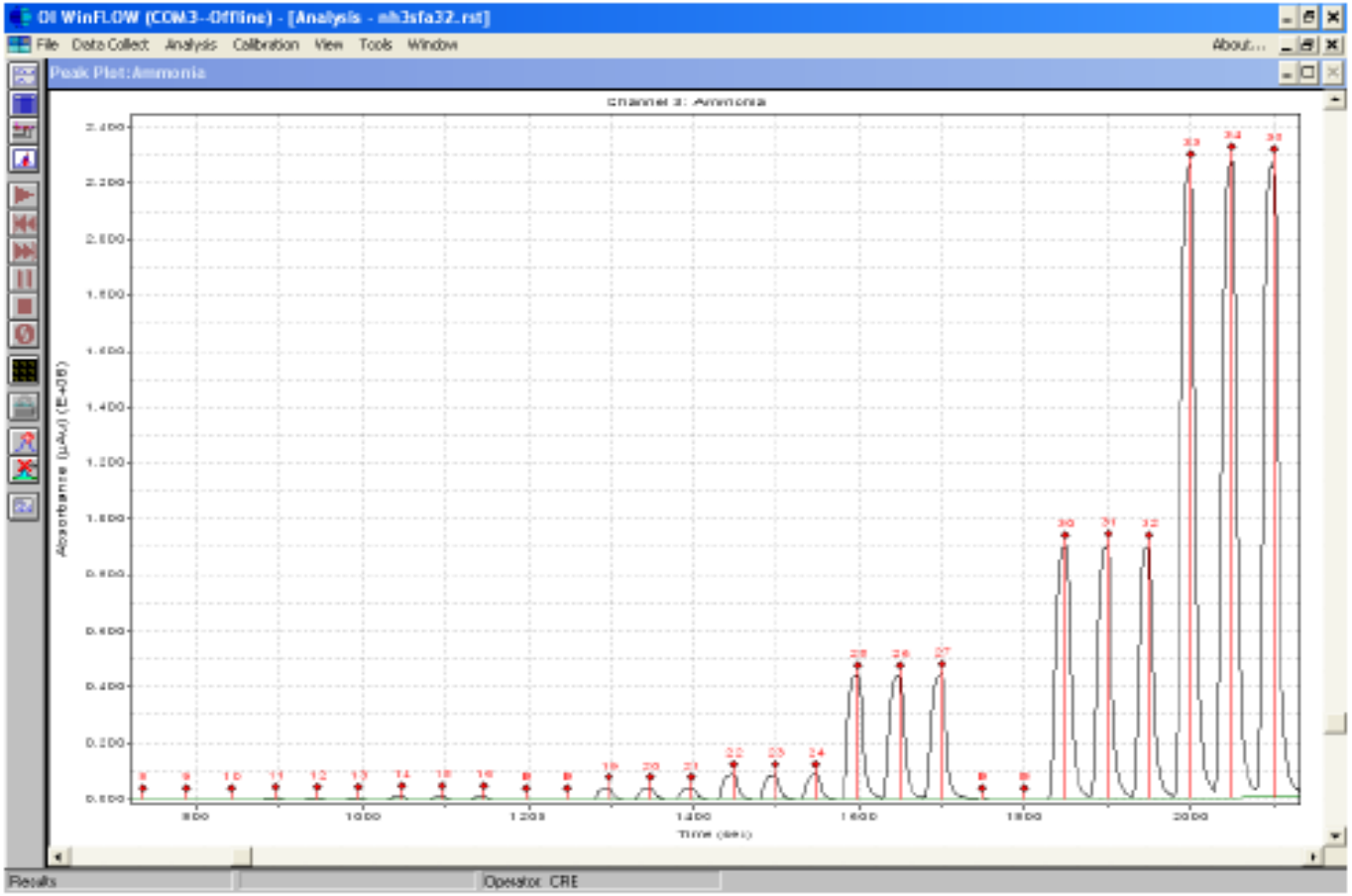
SFA Peaks: Ammonium



CN

NH_3

PO_4

NO_3

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Advantages of SFA

- Low MDL
- Excellent Precision
- Steady state reactions
- Limited dispersion
- High throughput
- Easily expandable

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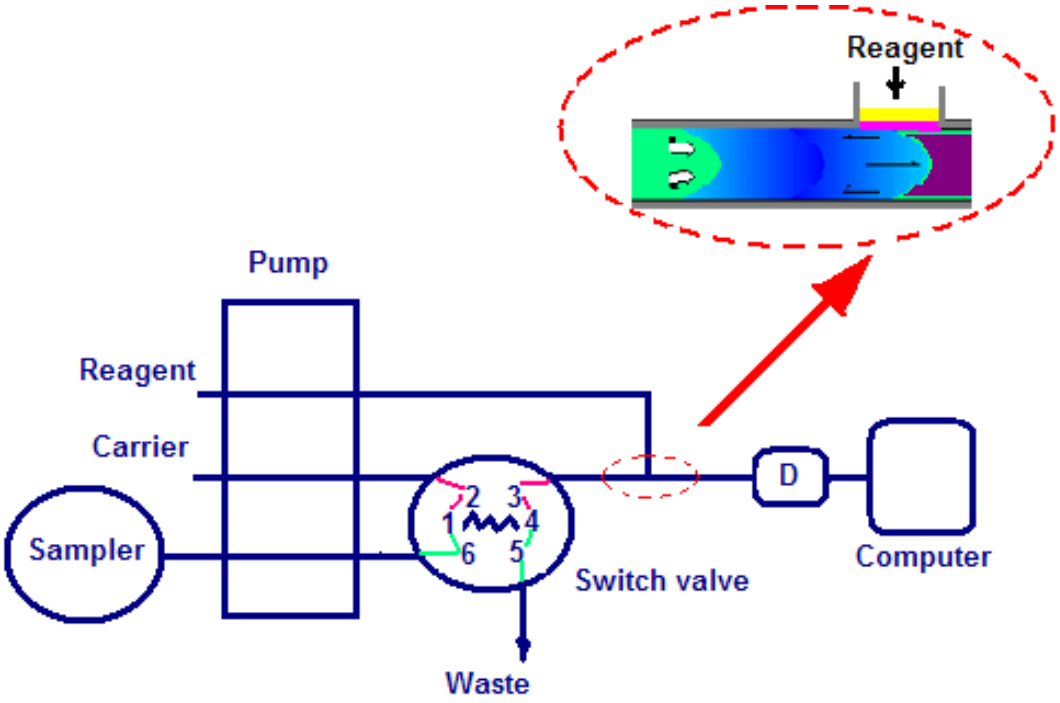
Flow Injection Analysis (FIA)



– The No Bubble Alternative

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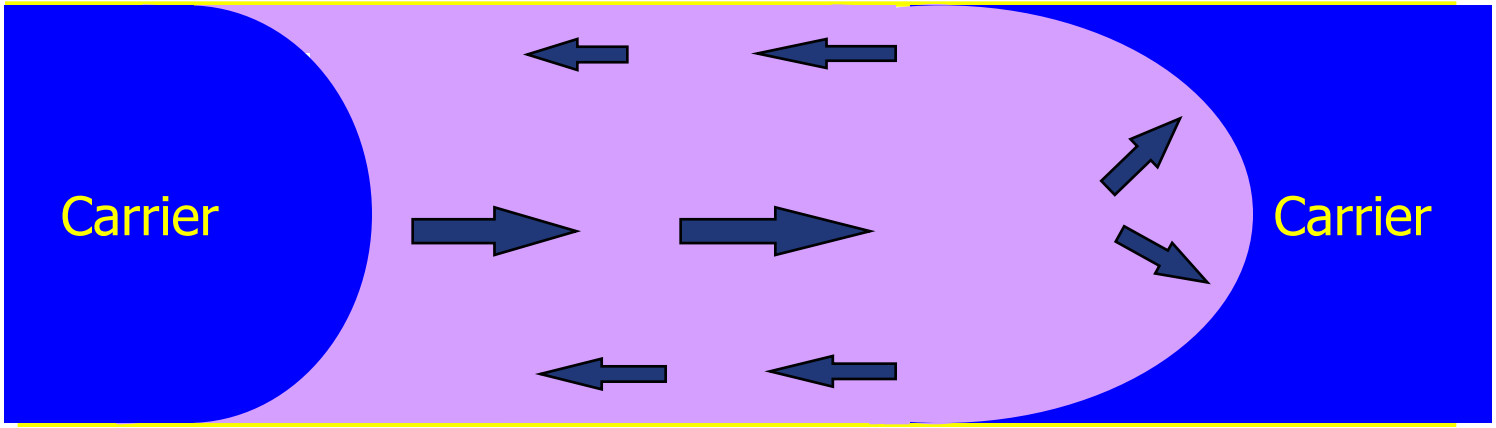
FIA Sample Segment



Sample segment

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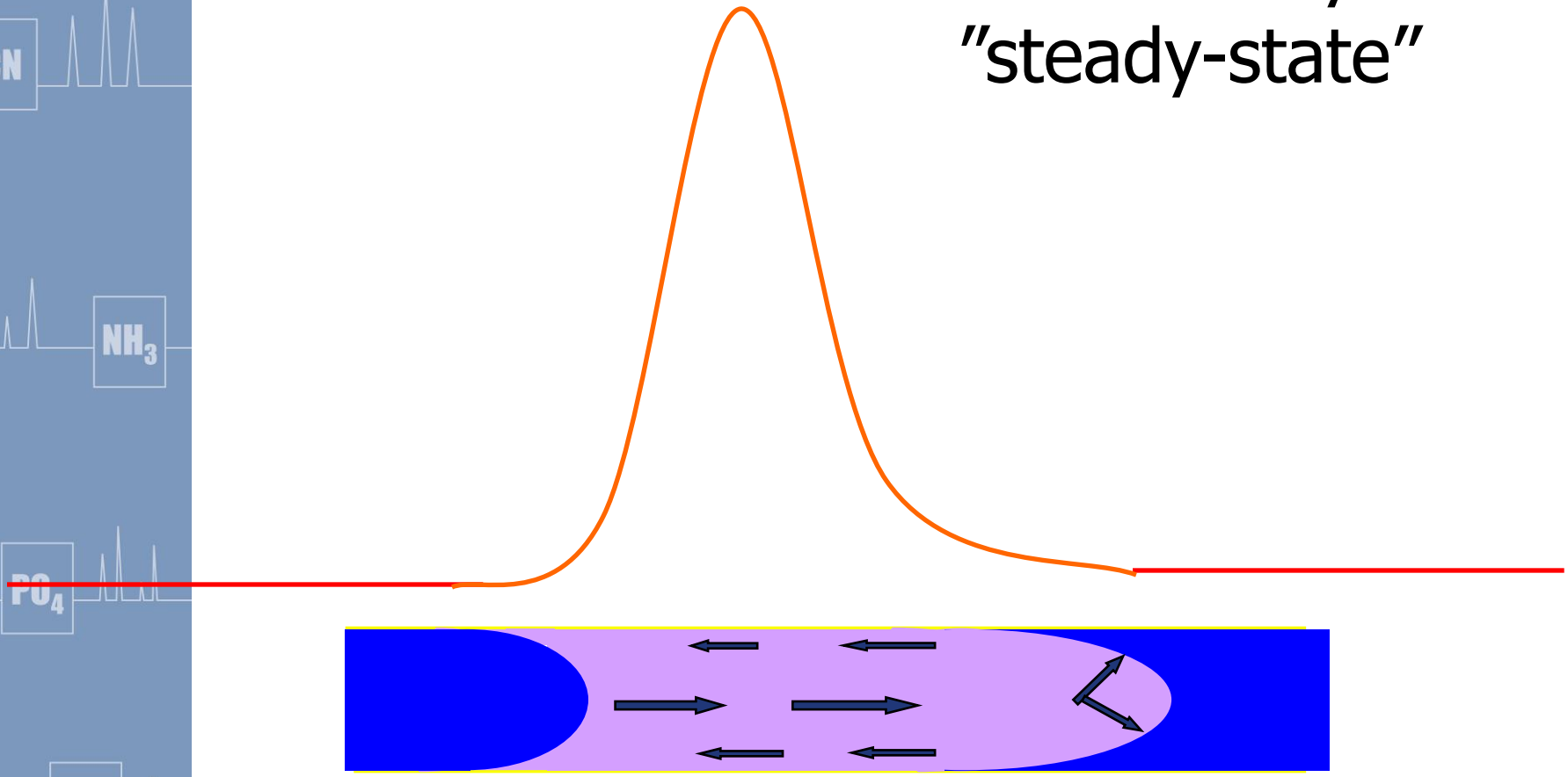
FIA Peak Shape

Not normally at
"steady-state"



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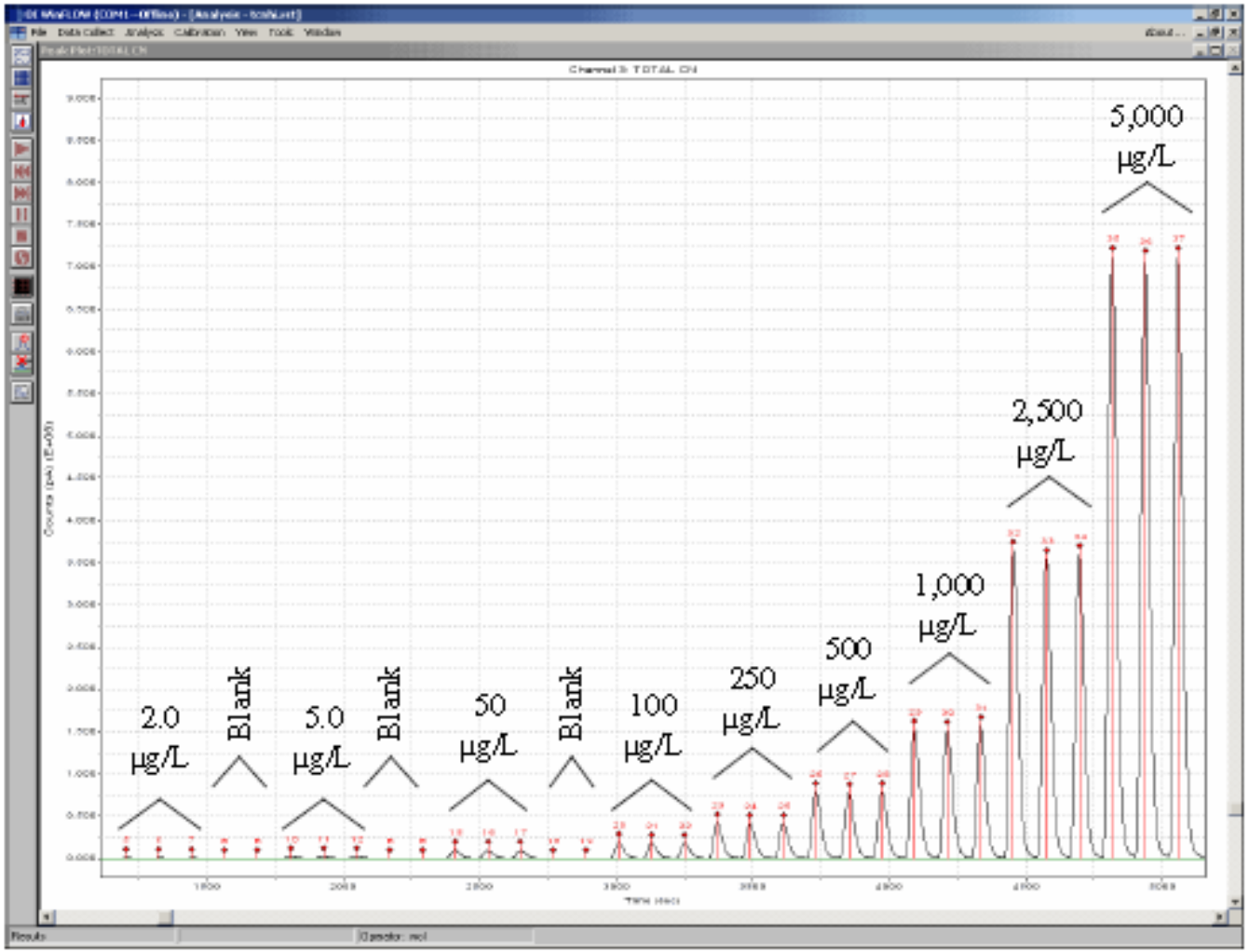
FIA Peaks: Cyanide



CN

NH_3

PO_4

NO_3

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Advantages of FIA

- High throughput
- Excellent Precision
- Ease of use
- No de-bubbling
- Rapid startup and shutdown

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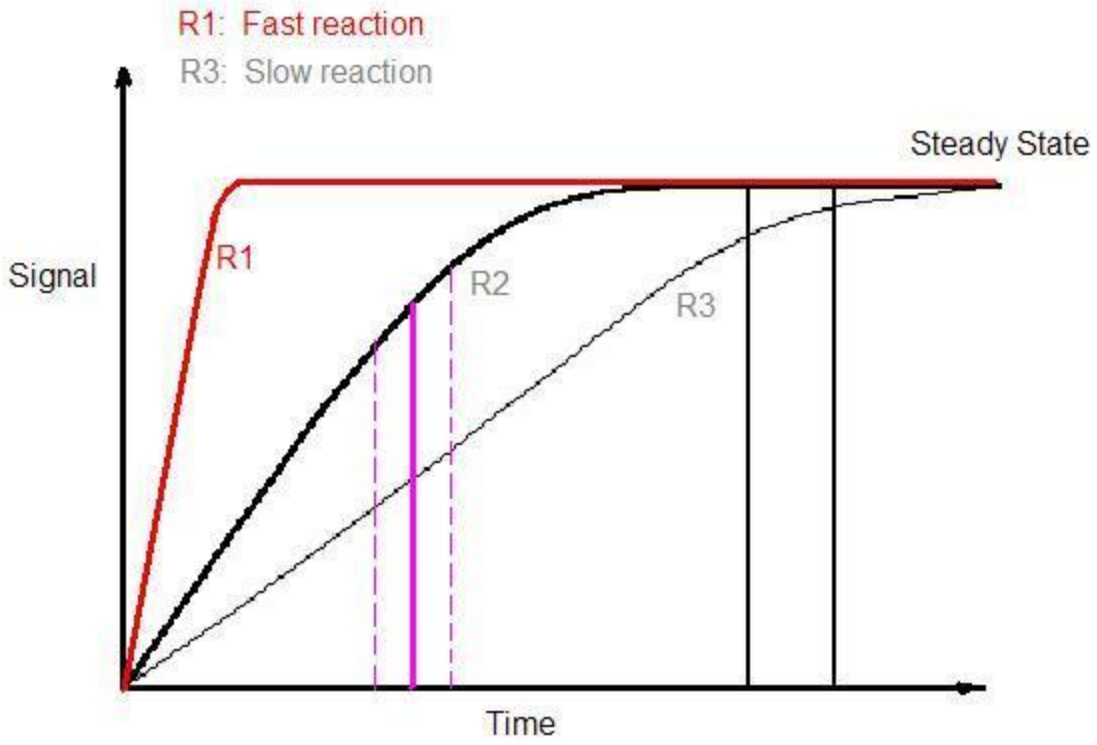
SFA vs. FIA



CN

NH_3

PO_4

NO_3

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Comparing SFA & FIA*

	SFA	FIA
Sample intro	aspiration	injection
Volume	200 ul	200 ul
Max delay time	10 minutes	2 minutes
Sample/hour	40 - 90	30 - 120
RSD	< 2%	< 2%
Reagent (ml)	2 - 3	2 - 4

* OI Analytical FS3100

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When to Use CFA

Choose CFA when automating a lot of samples for a few tests!

Exception – CNSolution

- no distillation makes CN analysis economical regardless of sample load

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Discrete Chemical Analysis…

… an alternative approach to automated chemical analysis

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What is a Discrete Analyzer?

Reactions in individual cuvettes
Mixing within the cuvette
Measurement within the cuvette

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Multi-chemistry Analyzer

True Random Access

Automatic Method Interchange

"Hands off" operation

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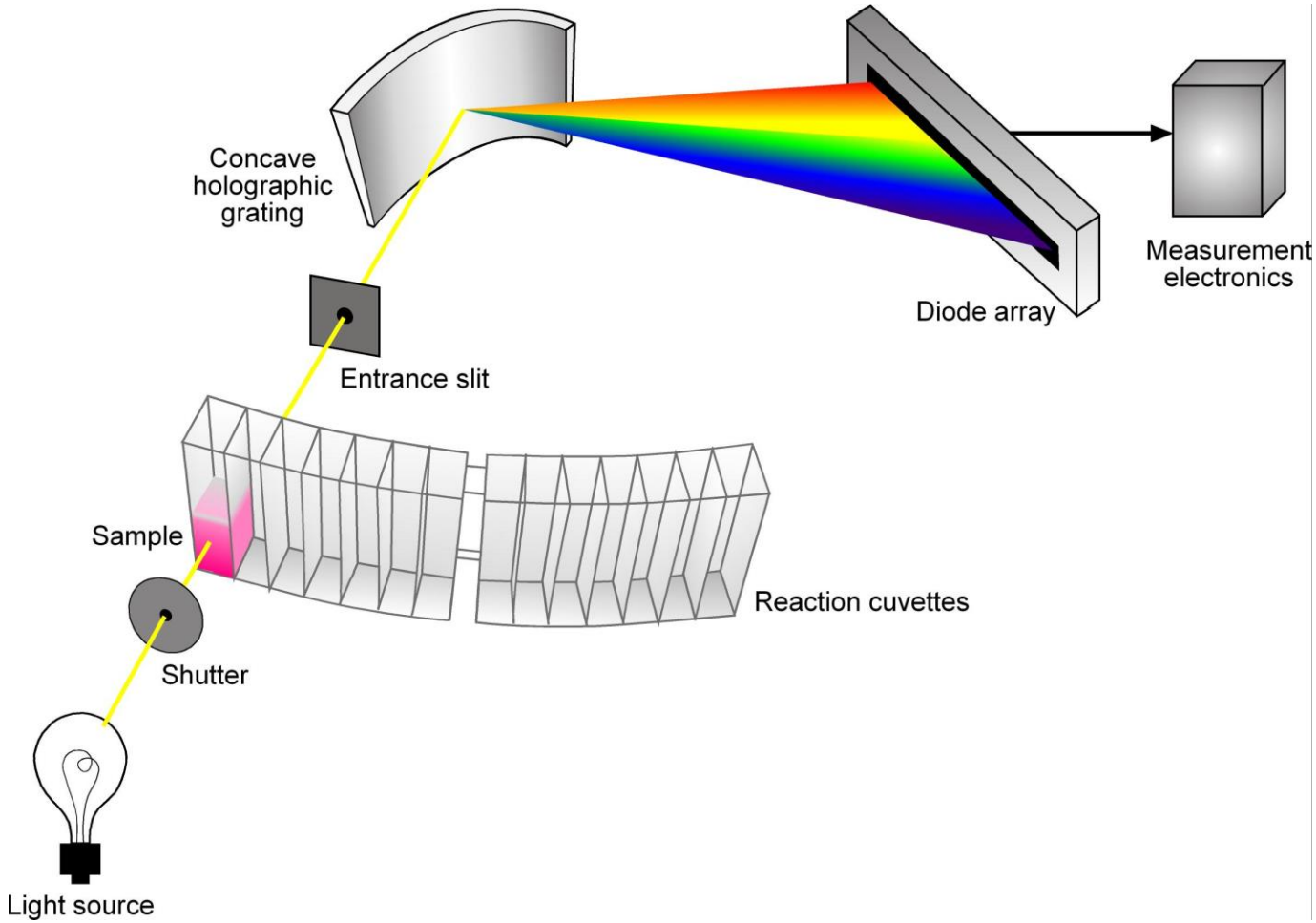
Chemical Analysis Made Simple



CN

NH_3

PO_4

NO_3

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Discrete Analyzer - Operation

Sample dispensed into cuvette

Reagents added to sample

Sample incubates in cuvette

Instrument measures absorbance

Result calculated

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Discrete Analyzer - Operation

No peaks – single absorbance reading

No interaction between samples

Equilibrium reactions (maximum color)

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Discrete Analyzer Benefits

- Reduces Turn Around Time
- Unattended Operation
- Only runs requested tests
- Standards Prepared Automatically
- Automatically Dilutes over-range samples
- No pump tubes

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When to Use Discrete

Choose discrete when automating a few samples for a lot of tests.

Choose a discrete analyzer when running a variety of matrices, or parameters.

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ACA Applications

Water utilities,

Environmental contract labs,

Government agencies,

Manufacturing,

Academia,

Mining

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EPA Methods

Drinking Water

Wastewater

Storm water

Biosolids

Groundwater

Hazardous Waste

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Soil & Plant Extracts

Potassium Chloride

Bray

Olson

Mehlich

Morgan

Acetic Acid

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Industrial Analysis

Seawater

Process water

Electroplating

Precipitation

Impinger Solutions

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Comparing CFA & Discrete

	Discrete	**CFA**
Reagents	per test	Continuously flowing
Carryover	None	Need wash solution
Throughput	Function of # reagents	Determined by peak width

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Comparing CFA & Discrete

	Discrete	CFA
Sensitivity	Standard Detector	ER Detector
# Tests per run	Limited by programming	Limited by # detectors
Fluid System	Disposable cuvettes	Pump tubes

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Comparing CFA & Discrete

	Discrete	CFA
Operator maintenance	Limited	Change pump tubes
Initial setup per test	none	5 – 10 minutes
Final teardown per test	none	5 – 10 minutes

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Choosing an ACA Technique

The technique to use depends on:

- Sample load
- Tests per sample
- Analytical Requirements (MDL, etc)

Make educated choice on what is best for your application

Examples Automated Analyzers

FS 3100

FS IV⊕

CN Solution 3100

DA 3500

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For Additional Information

Please visit our website at:

www.oico.com

Questions and Comments?

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